Sistemas de Comunicaciones

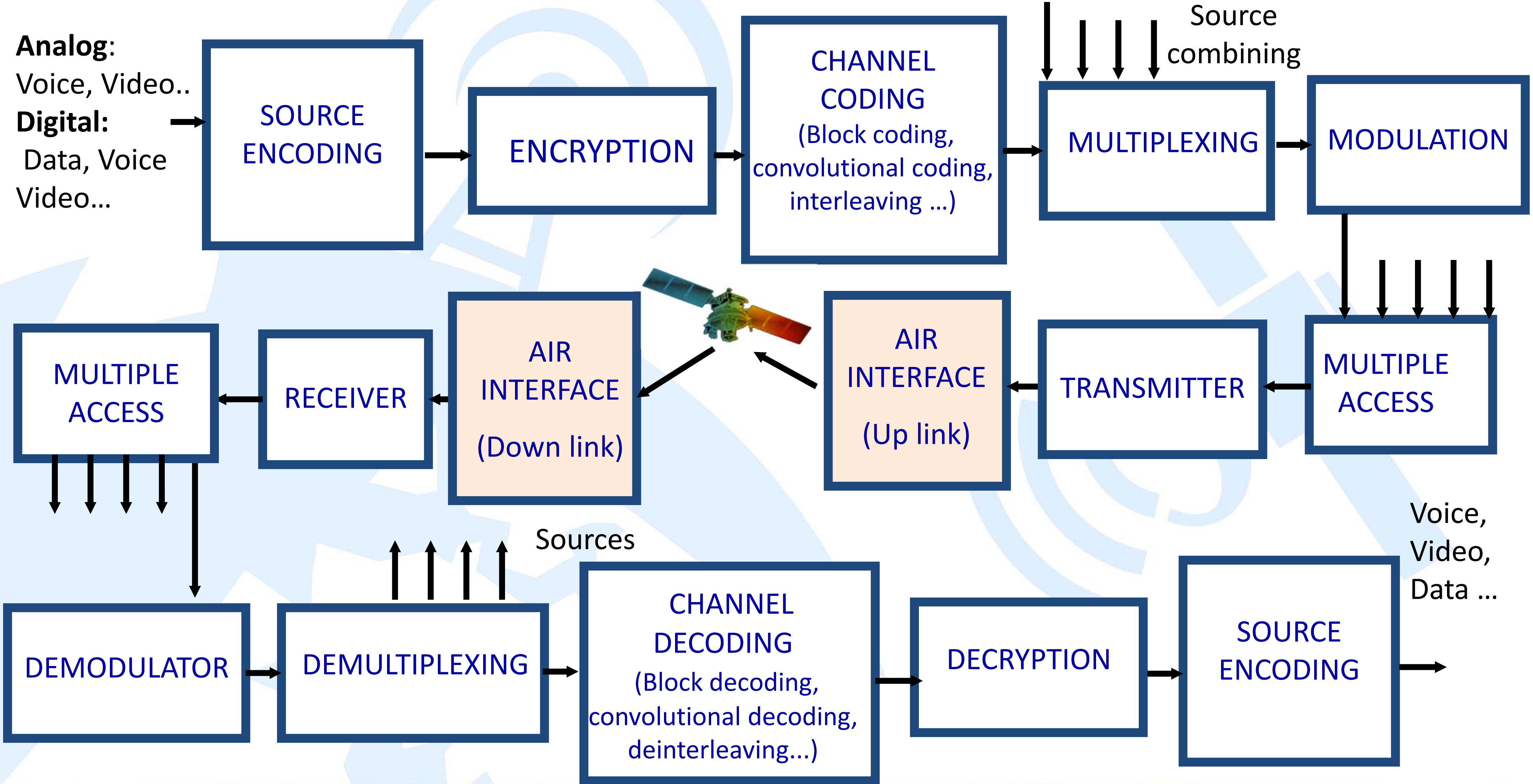
NEW SATELLITE COMMUNICATION SYSTEMS AND GLOBAL POSITIONING

2

Radio Frequency Transmission Systems (basic concepts)

Overview

2.1. Elements of a communication channel



The essential processes are the following:

Source encoding: performs the analogic to digital conversion (when the source is analogic) and eliminates any redundancy in the information.

Channel encoding: transforms the signal to improve the system’s performance in response to degradation factors introduced by the environment; performs manipulations with bits (interliving, randomization for energy dispersion,…) and introduces some redundancy in the information to detect and/or correct errors.

Encryption: set of techniques that are used to protect the information in a way that only authorized users have access to it..

Multiplexing: the organizing and packaging of one or more sources in a way that allows their separation upon reception.

Modulation: adapts the information to be transmitted to the channels characteristics, and also allows for the sharing of the physical medium. Given a certain technological capacity, the modulation technique it uses is what optimizes the communication in the physical medium.

Multiple access: techniques than enable the sharing of the physical medium by several communication channels.

All are well-known processes, we will only go over some basic concepts.

2.2. Channel encoding and modulation

Channel encoding

- The medium used in satellite-based communications is **limited in power** (long links and limited power of the satellite), there are **interferences** from other systems and it is **disturbed by the atmosphere**.

- **Errors in the transmission of symbols**. Requires **complex channel encoders**.

Two types of techniques:

-**ARQ** (Automatic Repeat reQuest).

- **FEC** (Forward Error Correction).

Comparison of the error control coding techniques

Coding technique	Through-put	Packet buffer	Performance	Delay	Return channel	Decoding	Bit rate
FEC	High	No	Medium/high	Short	No	Complex	High/very high
ARQ	Low	Yes	Very high	Long	Yes	Simple	Low/medium
Hybrid (HEC)	Medium	Yes	High	Medium	Yes	Medium	High

HANDBOOK ON SATELLITE COMMUNICATIONS (HSC). International Telecommunications Union . April 2002

- Since many of the satellite-based communication services **lack a return channel** and, furthermore, since the **delay of the channel** (around 300 milliseconds for geostationary satellites) is very high, ARQ techniques are not used.

Error-correcting codes:

- *Linear block codes* (**LDPC** (Low Density Parity Check) codes, Reed-Solomon codes)
- *Cyclic codes (***BCH** (The Bose, Chaudhuri, and Hocquenghem codes)
- *Convolutional codes* (Viterbi or Trellis codes)
- T*urbocodes* (encoding with interleaving).

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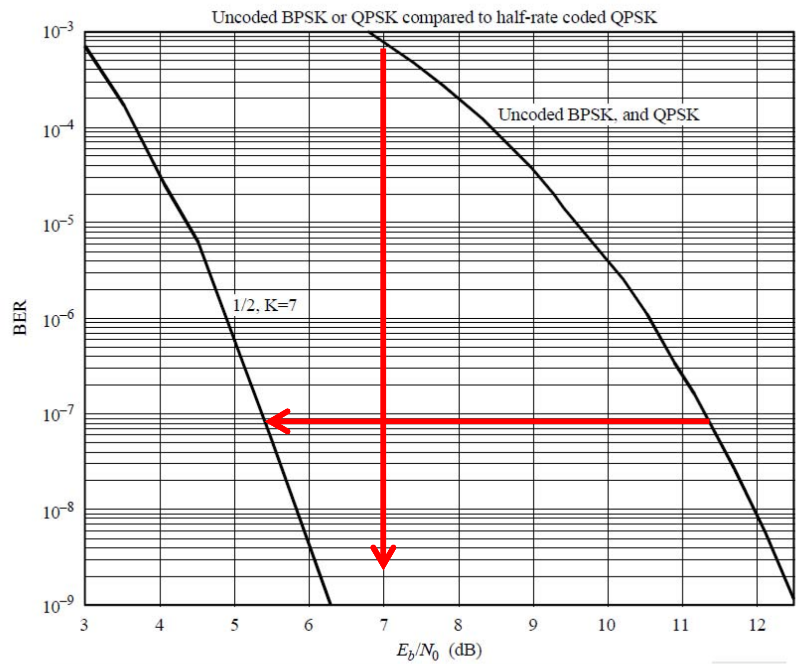
TABLE 3-6

Examples of the use of FEC on satellite digital links

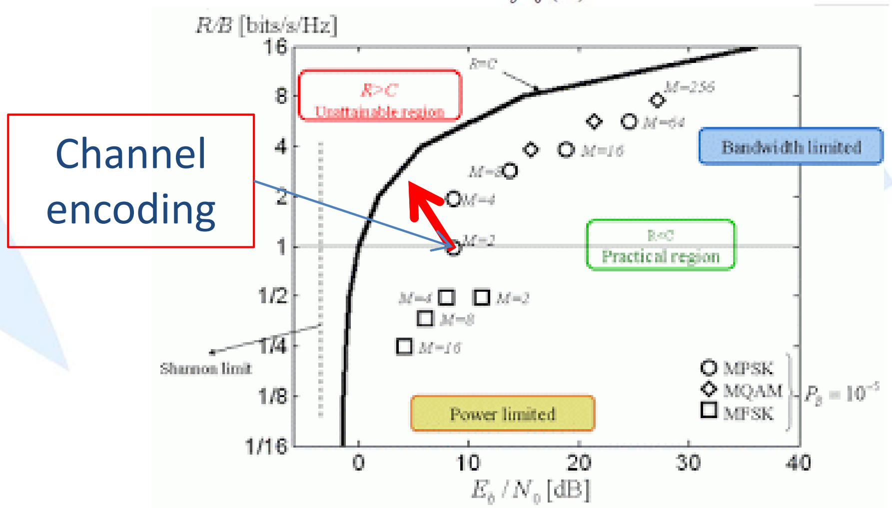
Satellite system	Access mode	Info. bit rate	Type	R	Length	Distance	Decoding algorithm	Gain or improvement in BER
Intelsat	FDMA/ SCPC	48 kbit/s 56 kbit/s	self-orthogonal convolutional	3/4 7/8	80 384	5 5	threshold	10^{-4} to 5.10^{-9} 10^{-4} to 5.10^{-8}
		≥4.8 kbit/s	shortened Hamming	14/15	120	4		
Intelsat	TDMA	105 Mbit/s	BCH (128, 112)	7/8	128	6	table look-up	2.5 dB for 10^{-5}
		assignment channel	extended Golay (24, 12)	1/2	24	8		
Telecom 1	TDMA	nx64 kbit/s	Hamming	4/5	40	4	table look-up	10^{-6} to 10^{-10}
Telecom 1	FDMA	8 Mbit/s 34 Mbit/s	convolutional	2/3	5	5	Viterbi	4.5 dB for 10^{-5}
		48 kbit/s data	convolutional (Idaware)	3/4	3	3	threshold	10^{-4} to 10^{-11} burst errors
Eutelsat SMS Intelsat IBS	FDMA	nx64 kbit/s	convolutional	1/2	7	10	Viterbi	
Intelsat IDR	FDMA/ SCPC	nx64 kbit/s 1.5/2-8 Mbit/s up to 45 Mbit/s	convolutional & punctured	1/2 3/4 7/8	7	10 5 3	Viterbi	
Intelsat IDR NG	FDMA/ SCPC	nx64 kbit/s 1.5/2-8 Mbit/s	RS(219, 201) + convolutional & punctured	1/2 3/4 7/8	7	19(RS)	Viterbi Algebraic	
		up to 45 Mbit/s	RS (219, 201) + 2/3 PTCM 8PSK		7	19(RS)	Viterbi Algebraic	
SBS	TDMA	48 Mbit/s	Shortened Reed-Solomon (204, 192)	16/17	204	13	Algebraic	10^{-4} to 10^{-11}
TVSAT	TDM	900 kbit/s	BCH (63, 44)	44/63	63	8	Algebraic	
Inmarsat Std B	SCPC	300/ 600 bit/s	convolutional	1/2	7	10	Viterbi	+ interleaving
Inmarsat Std C	SCPC	9.6/ 16 kbit/s	punctured	3/4	7	5	Viterbi	Audio quality for 10^{-3}

Other processes:

- *Interleaving* (protects from errors at bursts).
- *Bit randomization* (dispersal of energy).



Normally, the goal of encoding is to **reduce the BER**, or **reduce the value of the Eb/No** required, even at the expense of using a wider bandwidth. The figure shows the coding gain obtained with an encoding that doubles the original bandwidth. It is however, possible to have a coding gain without a bandwidth expansion using trellis-coded modulation.



More detailed information on these techniques can be found in:

- *John G. Proakis, Masoud Salehi, "Communication Systems Engineering", 2nd ed., Prentice Hall, 2002.*

- *Bernard Sklar, "Digital Communication", 2nd ed., Prentice Hall, 2001*

Its application to satellite-based systems can be found in:

- *Appendix 3.2. HANDBOOK ON SATELLITE COMMUNICATIONS (HSC). International Telecommunications Union . April 2002*

Finally, a practical case of the application in DVB standards can be found in:

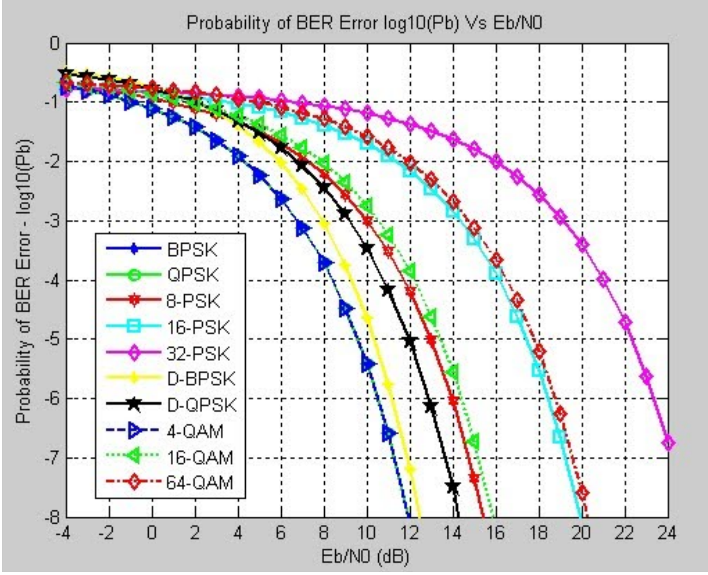
Apuntes de la asignatura "Sistemas de Telecomunicación". ETSIT

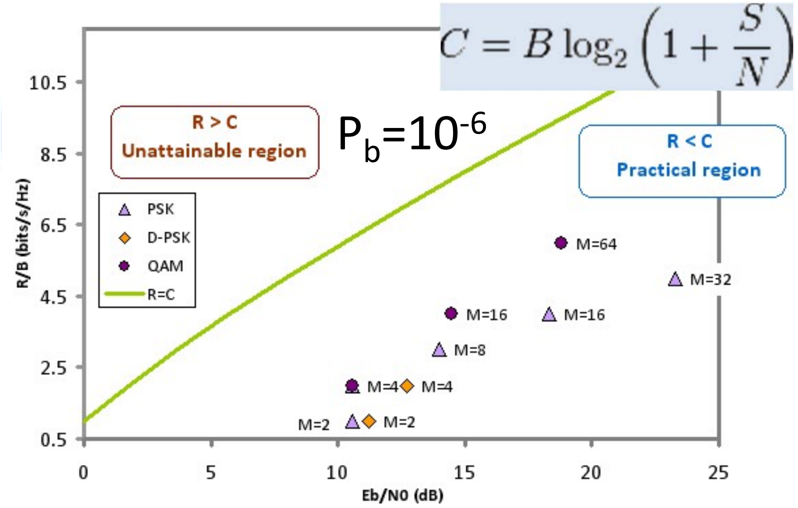
Digital Modulation

Conventional techniques

Modulation consists in the modification of a carrier's parameters (amplitude (ASK), frequency (FSK, MSK. GMSK), phase (BPSK, DPSK, QPSK, N-PSK, or a combination of them (QAM) in dependence on the symbol to be sent. The basic parameters of a modulation technique are **Bandwidth Efficiency** and **Power Efficiency**.

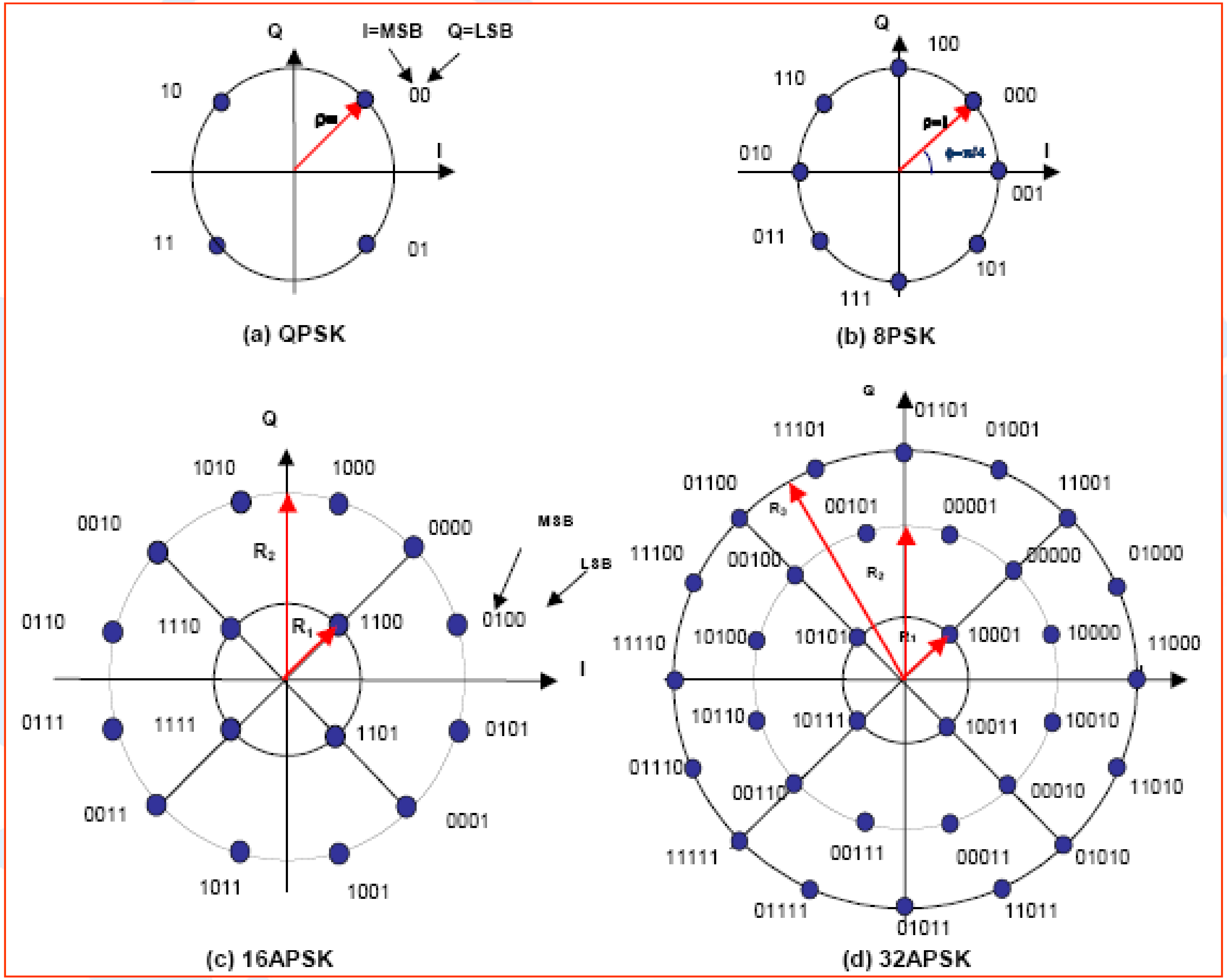
Bandwidth Efficiency describes the ability of a modulation scheme to accommodate data within a limited bandwidth. Increasing the data rate is achieved by decreasing the bit width of a digital symbol, which inevitably increases the bandwidth of the signal. Some modulations have better bandwidth efficiency than others (e.g. QAM). Unfortunately, these modulation schemes have less power efficiency.



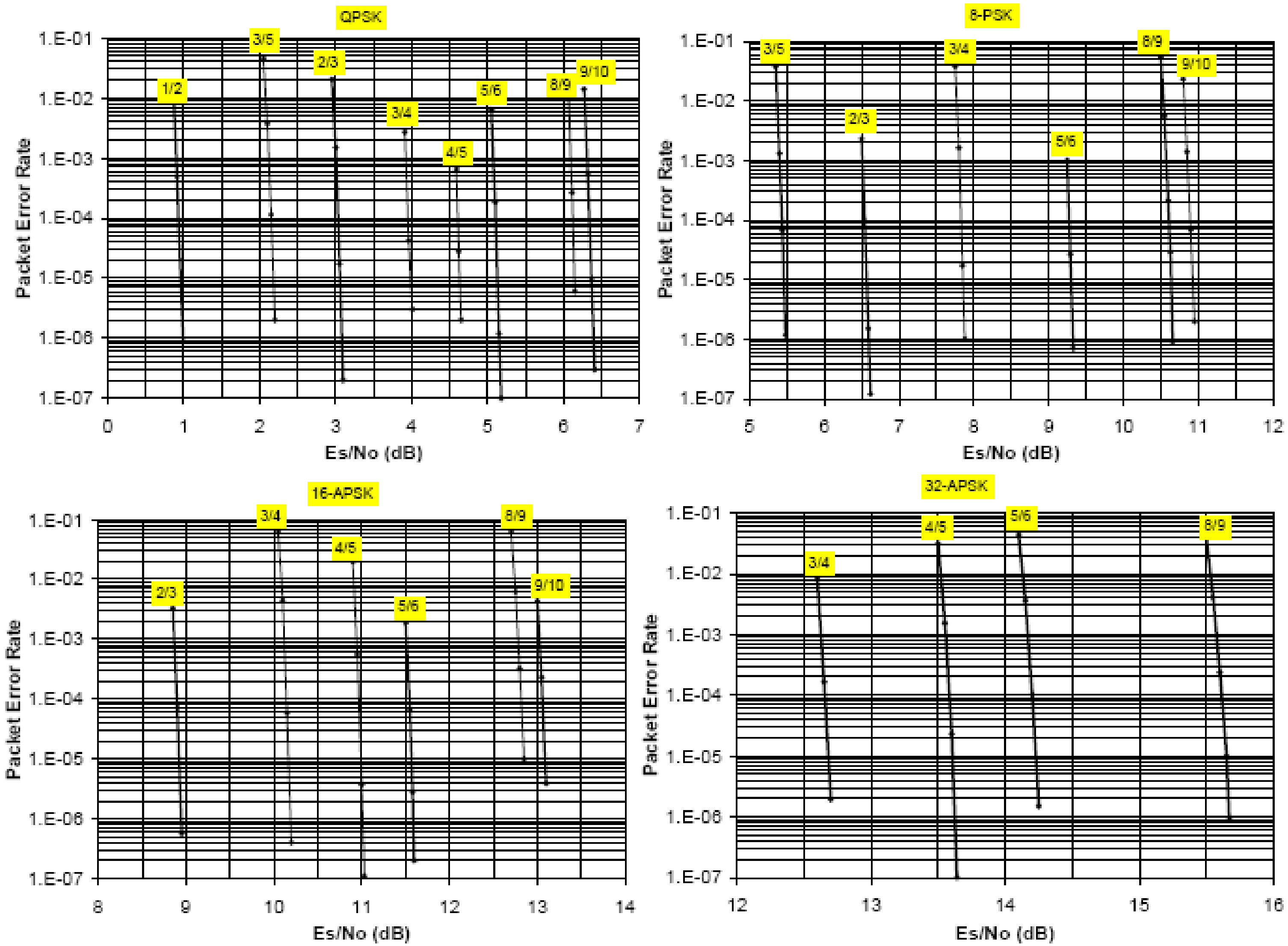


http://www.gaussianwaves.com/2010/04/performance-comparison-of-digital-modulation-techniques-2/

Digital Modulation



Channel coding + Digital Modulation (DVB-S2)



Question 2.1

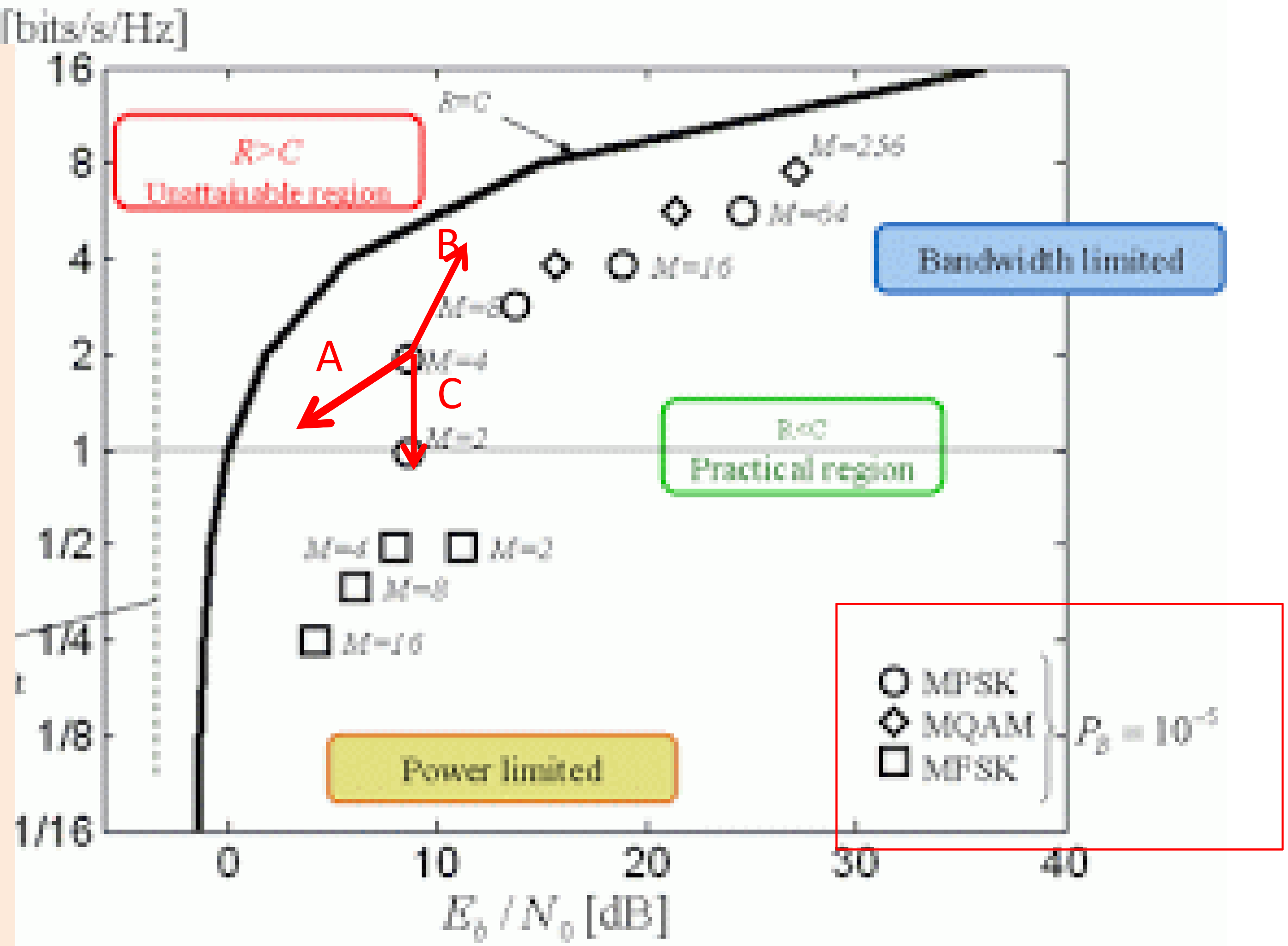
In a communication system a channel decoder is introduced so that the C/N is reduced for the same BER, without losing spectral efficiency. In the figure, the encoder is ?

ANSWER 1: A

ANSWER 2: B

ANSWER 3: C

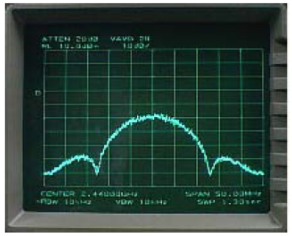
ANSWER 4 : None of the above



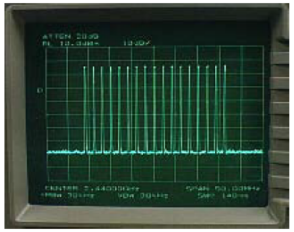
Spread spectrum techniques

Spread spectrum techniques employ a transmission bandwidth that is several orders of magnitude greater than the minimum required signal bandwidth. This is very bandwidth inefficient for a single user but if many users can simultaneously use the same bandwidth without significantly interfering with one another, **in a multiple-user environment, spread spectrum becomes very bandwidth efficient**.

DSSS



FHSS



This can be achieved by two different processes:

Direct Sequence Spread Spectrum (DSSS). The data being transmitted are multiplied by a pseudorandom sequence of 1 and −1 values, at a frequency much higher than that of the original signal and then modulated onto a fixed carrier. This is a code division multiple access (CDMA) technique which allows multiple transmitters to share the same channel within the limits of the cross-correlation properties of their PN sequences

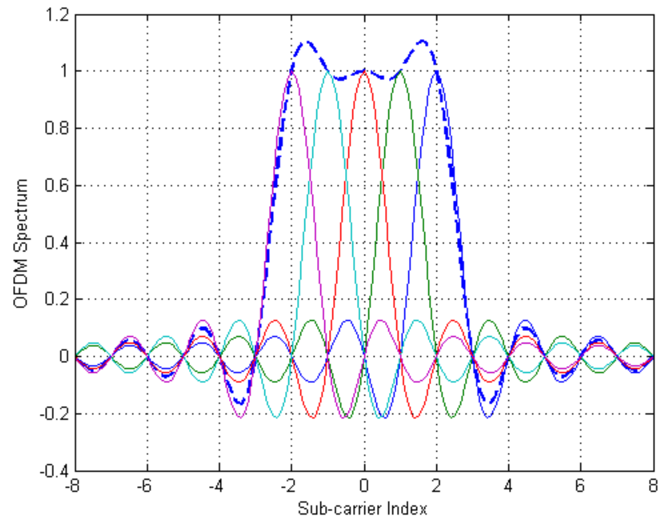
Frequency Hopping Spread Spectrum (FHSS). Signal is spread during modulation where the carrier frequency is rapidly changed according to a hopping sequence.

They are therefore characterized by their **protection from interferences** and their suitability as a **multiple access technique**.

Orthogonal Frequency Division Multiplexing (OFDM) techniques

The OFDM is a modulation scheme. Having multicarrier transmission techniques here means that the available spectrum is divided into many carriers, each one modulated at a low rate data stream. The spacing between the carriers is closer and the carriers are **orthogonal** to one another preventing interferences between the closely spaced carriers, hence OFDM can be thought of as a **combination of modulation and multiplexing techniques**. Each carrier in a OFDM signal has very narrow bandwidth so the resulting symbol rate is low which means that the signal has **high tolerance to multipath delay spread** reducing the possibility of inter symbol interferences (ISI).

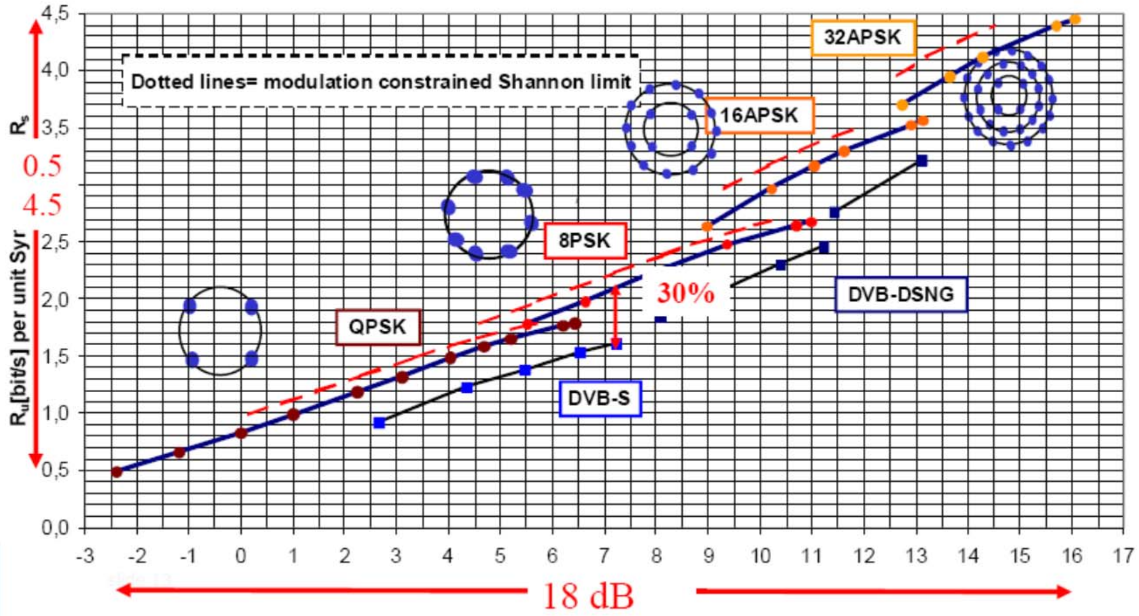
Examples:
Digital Audio Broadcasting (DAB)
Digital Video Broadcasting over the terrestrial network
Wireless LAN
LTE



Adaptive Coding and Modulation Techniques

- Ability to change the encoding and modulating technique used en each moment in response to the environment's requirements.

- High-complexity techniques that use highly-sophisticated signal processors which are low-cost in massive applications thanks to system standardization.



A good overview of modulation techniques can be found in:

D.K.Sharma, A. Mishra & Rajiv Saxena "ANALOG & DIGITAL MODULATION TECHNIQUES: AN OVERVIEW". TECHNIA International Journal of Computing Science and Communication Technologies, VOL. 3, NO. 1, July 2010.

Question 2.2

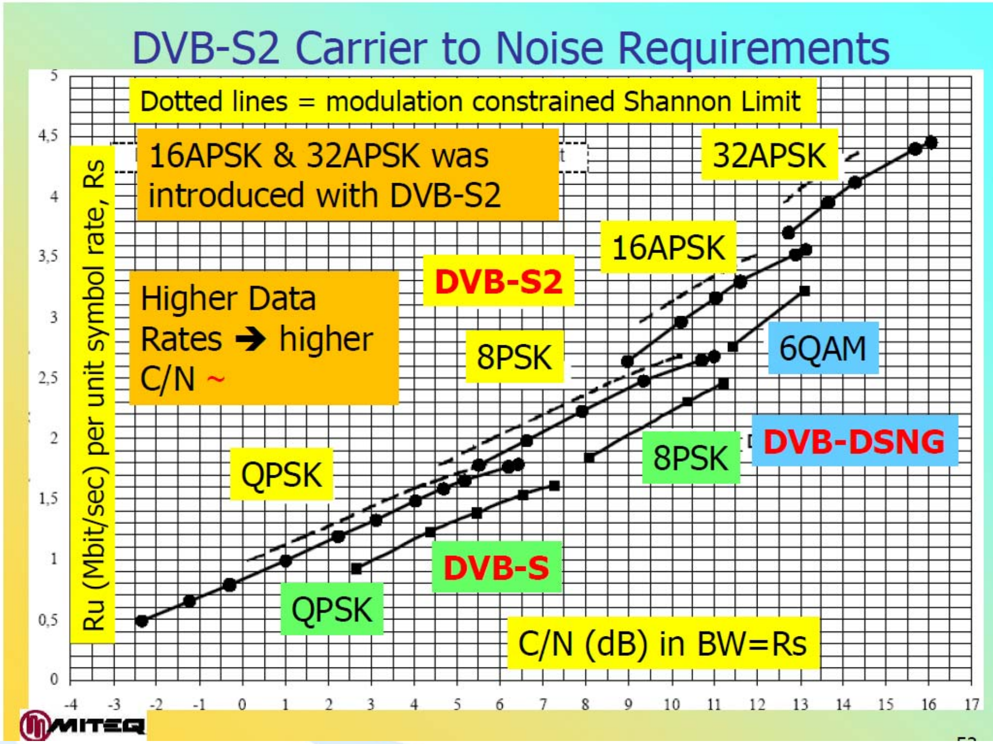
The adaptive coding and modulation techniques are used in DVB-S2 standard for satellite communication systems. The phase modulation schemes are very popular, because… ?

ANSWER 1: It is specially well suited for MPEG format.

ANSWER 2: it allows the use of transmitters near saturation.

ANSWER 3: They have higher spectral efficiency that M-QAM schemes

ANSWER 4 : They are well protected against multipath.



2.3. Multiple access in satellite communication systems

- In satellite communication **many users are active** at the same time and also, data traffic **varies over time** and is **very asymmetric**. The problem of simultaneous communications between many single or multipoint satellite users can be solved by using Multiple Access techniques:

- Frequency Division Multiple Access (**FDMA**)

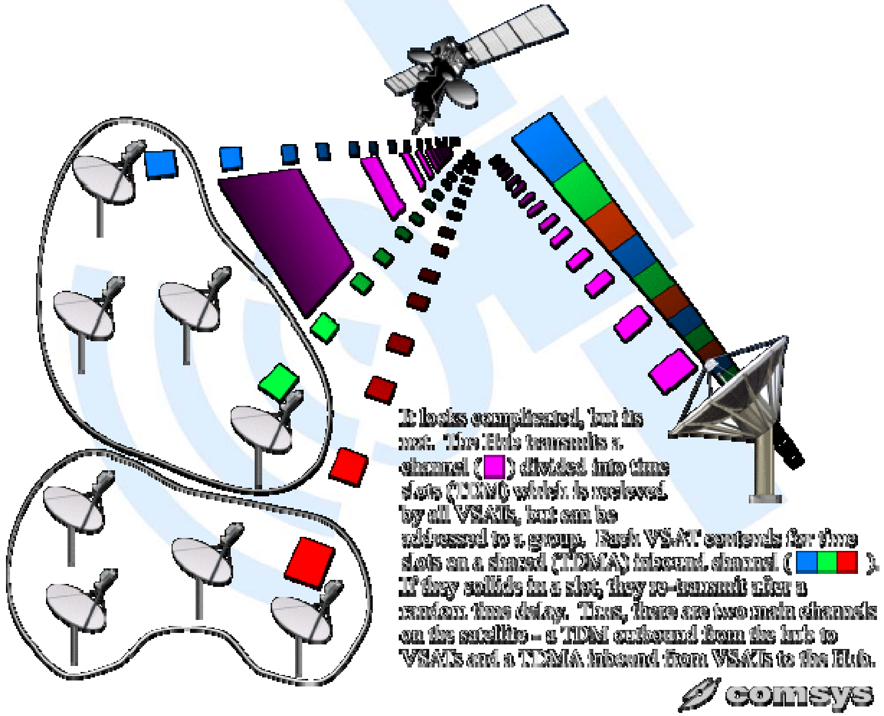
- Time Division Multiple Access (**TDMA**)

- Code Division Multiple Access (**CDMA**)

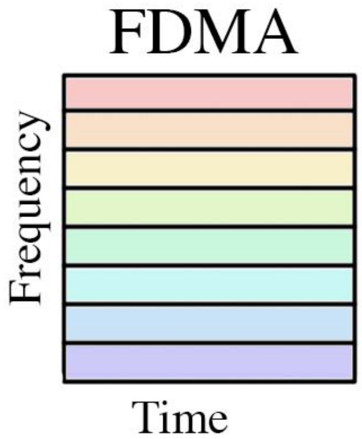
- Space Division Multiple Access (**SDMA**)

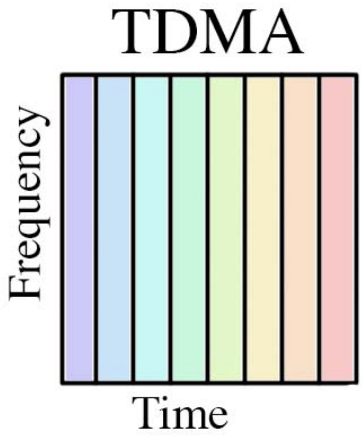
-Random (Packet) Division Multiple Access (**RDMA**)

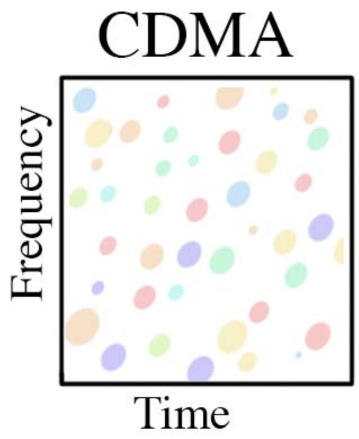
- **Hybrid Schemes!**



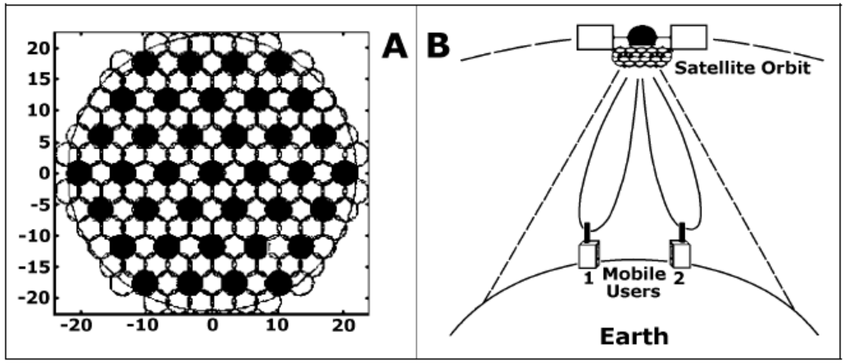
http://www.comsys.co.uk/wvr_nets.htm







SDMA

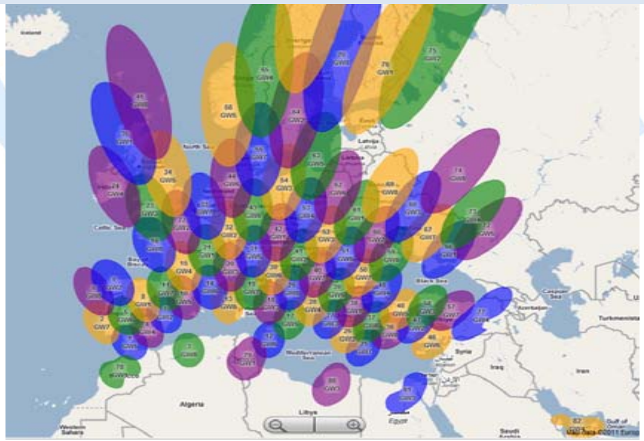


Zaharov V. & Others, “Smart Antenna Application for Satellite Communications with SDMA”, Journal of Radio Electronics, Moscow, 2001.

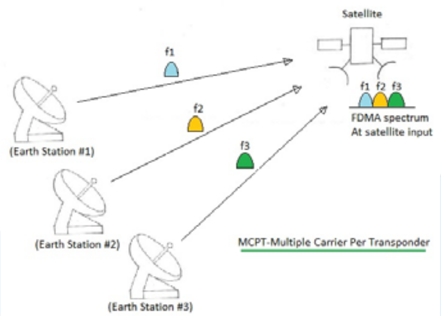
RDMA: Random (Packet) Division Multiple Access

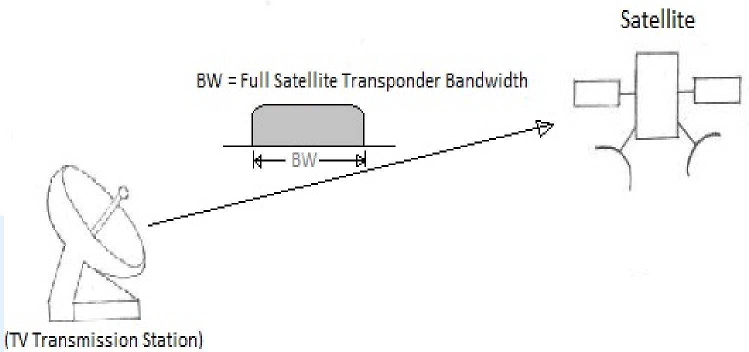
A large number of satellite users share synchronously the same transponder by randomly transmitting short burst or packet divisions.

SDMA or Cellular Technique?



- **Frequency Division Multiple Access (FDMA):**
  - Single Channels Per Carrier (SCPC)
  - Multiple Channel Per Carrier (MCPC)
  - Hybrids





- **Time Division Multiple Access (TDMA):**
  - TDM/TDMA
  - TDM/MF-TDMA (Multi-frequency TDMA)
- **Code Division Multiple Access (CDMA):**
  - Direct Sequence DS-CDMA
  - Frequency Hopping FH-CDMA
- **Space Division Multiple Access (SDMA):**
  - Reconfigurable beams (cellular technique)
  - *Adaptive array antenna*
  - Polarization-division multiplexing

SCPC (Single Channel per Carrier) is a satellite transmission system that employs a separate carrier for each channel. **MCPC (Multiple Channel per Carrier)** refers to the multiplexing a number of channels into a common digital bit stream, which is then used to modulate a single carrier that conveys all of the services to the end user.

FDMA advantages:

- Well established technology.
- No need for synchronization circuits.
- Any type of baseband or the type of modulation can be used.

FDMA disadvantages:

- Inter-modulation noise in the transponder leads satellite capacity reduction.
- Lack of flexibility in channel allocation.
- Requires up-link power control to maintain quality.

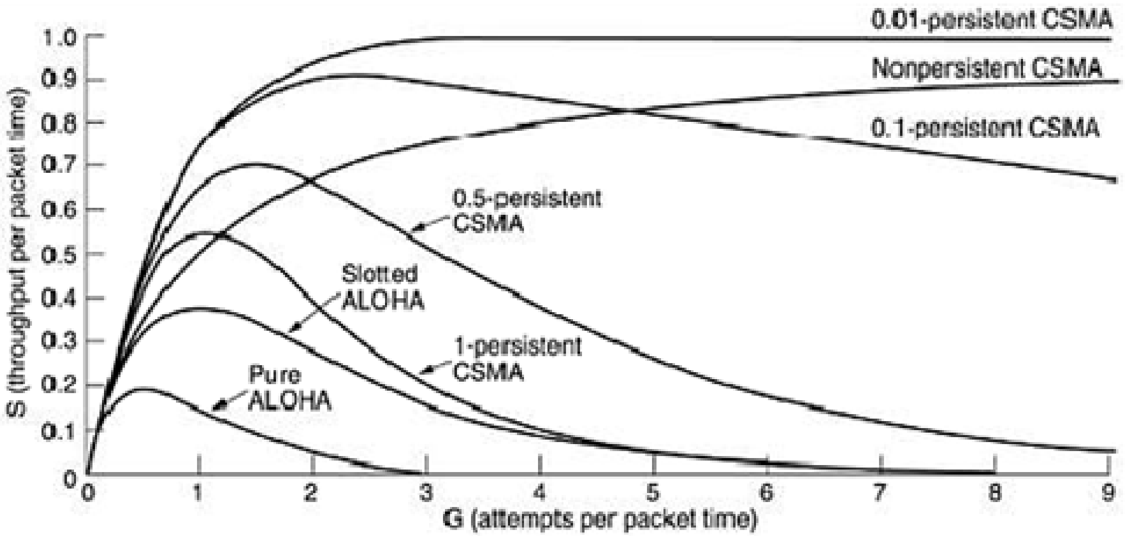
The multiple access technique **assignment strategy** can be classified into three methods:

- Pre-Assigned Multiple Access (PAMA)
(Communication links with a large amount of traffic)

- Demand-Assigned Multiple Access (DAMA).
Satellite channels are dynamically assigned to users according to the traffic requirements

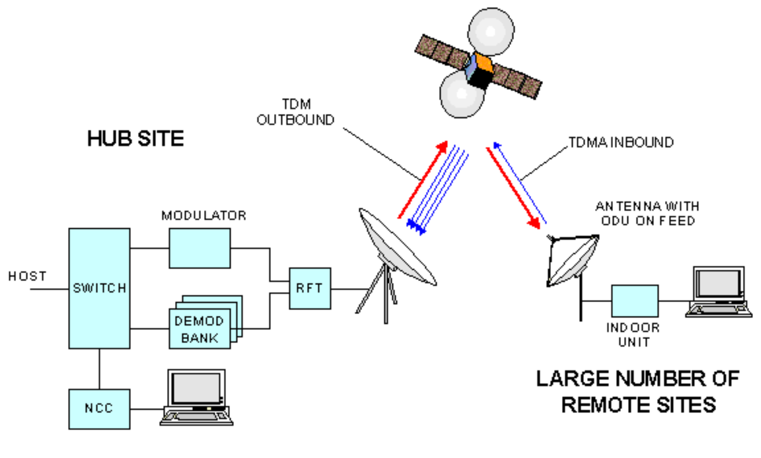
- Random Access (RA)

- **ALOHA**
- **SLOTTED-ALOHA**. Improvement of the ALOHA technique with time slots.
- **CSMA** (Carrier Sense Multiple Access)…. etc.

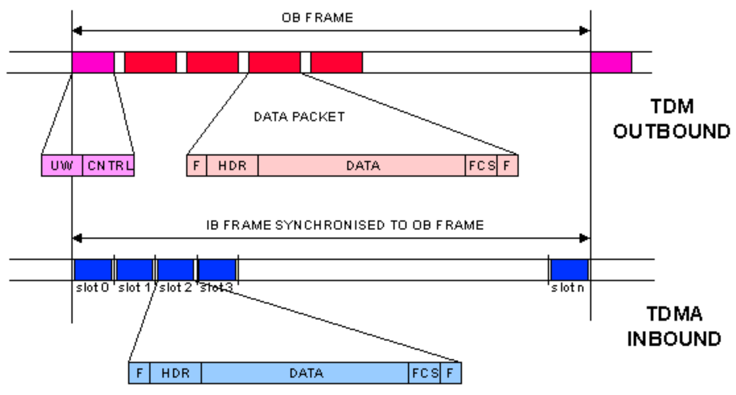


http://www.tutorsglobe.com/getanswer/explain-in-the-csma-protocol-in-detail-90210.aspx

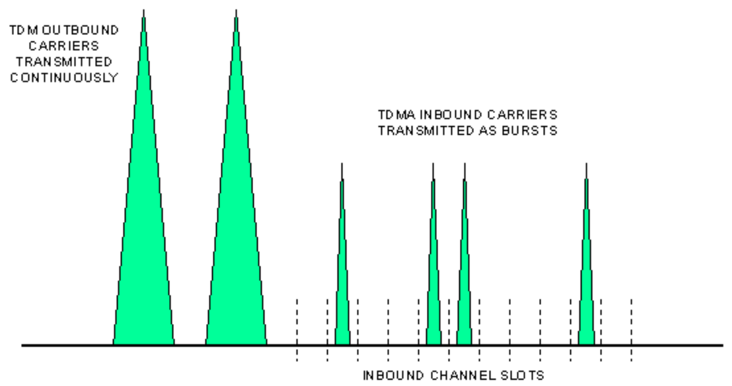
EXAMPLE: TDM/TDMA Interactive VSAT Networks



TDM/TDMA VSAT Network



TDM/TDMA VSAT Frame and Packet Format



TDM/TDMA VSAT Spectrum

TDM/TDMA VSAT Network

Signal Types and Characteristics

The outbound data stream from the hub is transmitted at a relatively high data rate (typically 56 to 1024 kb/s) using TDM. The bit stream consists of a synchronisation word followed by a series of messages in time slots directed towards individual VSAT terminals. Broadcast messages to all remote VSAT terminals are also generally permitted.

Outbounds are transmitted continuously (i.e. duty cycle 100%) as a TDM stream. The number of outbounds per network is determined by the traffic statistics, packet length as well as the outbound data rate.

The outbounds for a network are generally grouped together at either the top or the bottom of the leased bandwidth.

The inbound carrier is often accessed using ALOHA or Slotted ALOHA. If a higher capacity is required, a separate channel can be dedicated to ALOHA or Slotted ALOHA access requests and a demand assigned TDMA access scheme established.

Inbound slotted ALOHA carriers information rates are usually between 2.4 and 16 kb/s. Inbound TDMA or SCPC carriers used for file transfer usually have information data rates between 56 kb/s and 256 kb/s. All carriers are BPSK or QPSK modulated and have rate 1/2 or 2/3 Forward Error Correction (FEC). This ensures that bit error rates are low (typically 10^{-6} or 10^{-7} which is comparable to ISDN).

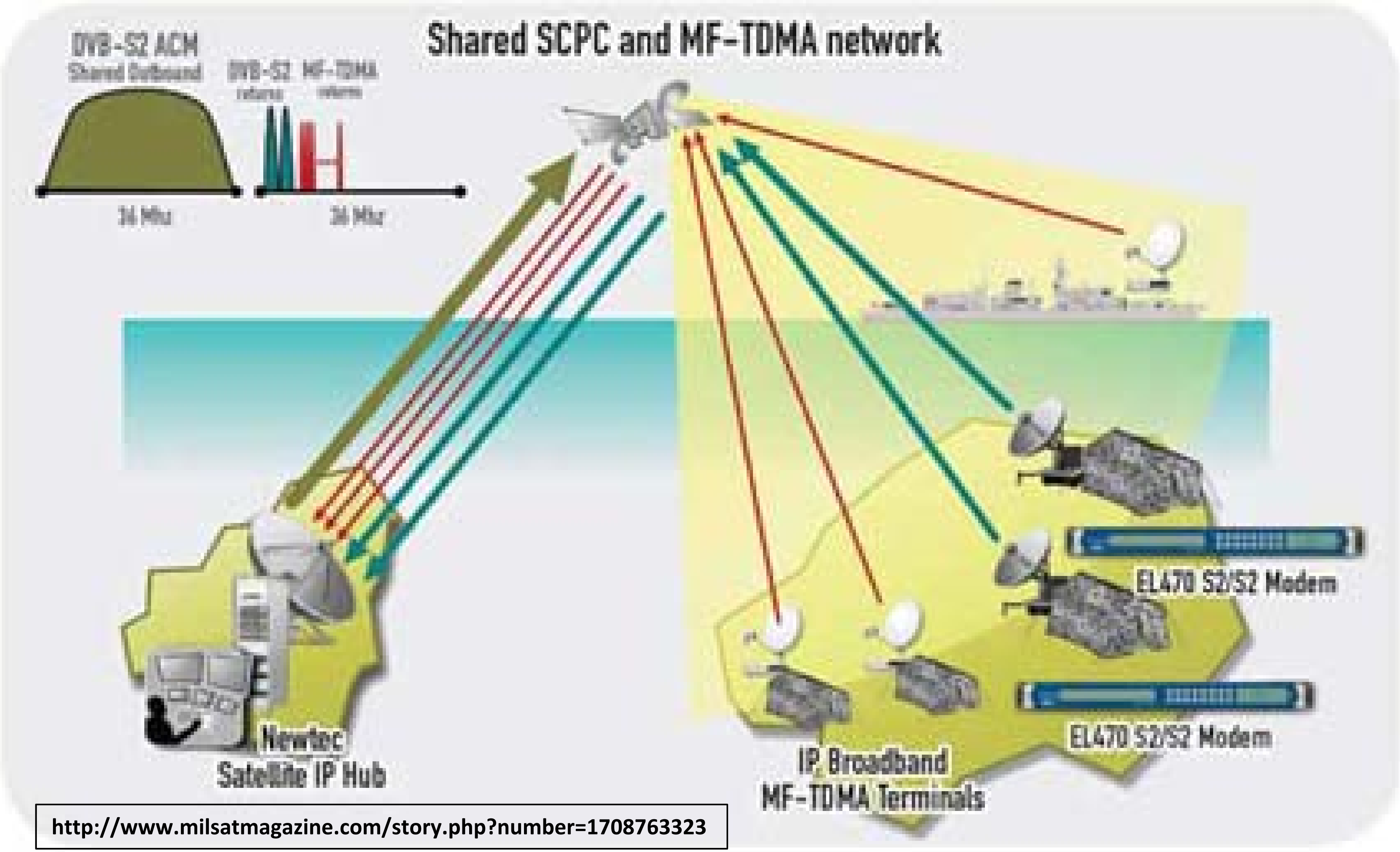
Remote terminals transmit in TDMA bursts in either a pre-assigned inbound channel slot or in any inbound channel slot depending on the manufacturer.

Several different inbound TDMA access systems are used depending on traffic characteristics and the manufacturer.

In a shared hub network, individual customers are often, but not always, allocated one or more dedicated outbounds and several inbounds.

If the traffic mix is a combination of short interactive messages and long file transfers it is often worthwhile to use a technique called Adaptive ALOHA/TDMA. VSATs which have large blocks of data to transmit request dedicated TDMA time slots and use TDMA. The other VSAT terminals in the network use slotted ALOHA and avoid the assigned time slots. Alternatively, dedicated SCPC carriers can be temporarily assigned for file transfer.

http://satway.net/understand_VSAT_Satellite_Technology.html



http://www.milsatmagazine.com/story.php?number=1708763323

2.4. Satellite communication standards

- A standard is nothing other than **a set of encoding, modulation (and multiple access techniques)**, adequate for a certain transmission problem. They allow for the **optimization** of a communication system. Standards are **assumed by stakeholders**, permitting their rapid diffusion and cheapening the cost of the equipment.

https://www.dvb.org/standards

DVB Key Standards

DVB-T2
DVB-C2
DVB-S2
DVB-S2X
DVB-IPTV
DVB-RCS2
DVB-CI-Plus
DVB-GEM

What is DVB?

The DVB Project is an Alliance of about 200 companies, originally of European origin but now worldwide. Its objective is to agree specifications for digital media delivery systems, including broadcasting. It is an open, private sector initiative with an annual membership fee, governed by a Memorandum of Understanding (MoU).

The Members of the DVB project develop and agree specifications which are then passed to the European standards body for media systems, the EBU/CENELEC/ETSI Joint Technical Committee, for approval. The specifications are then formally standardised by either CENELEC or, in the majority of cases, ETSI.

http://www.dvb.org

Types of ETSI Standards

- **European Standard (EN)** – Used when the document is intended to meet needs specific to Europe and requires transposition into national standards, or when the drafting of the document is required under a mandate from the European Commission (EC)/European Free Trade Association (EFTA). An EN is drafted by a Technical Committee and approved by European National Standards Organizations.
- **ETSI Standard (ES)** – Used when the document contains technical requirements. An ES is submitted to the whole ETSI membership for approval.
- **ETSI Guide (EG)** – Used for guidance to ETSI in general on the handling of specific technical standardization activities. It is submitted to the whole ETSI membership for approval.
- **ETSI Technical Specification (TS)** – Used when the document contains technical requirements and it is important that it is available for use quickly. A TS is approved by the Technical Committee that drafted it.
- **ETSI Technical Report (TR)** – Used when the document contains explanatory material. A TR is approved by the Technical Committee that drafted it.
- **ETSI Special Report (SR)** – Used for various purposes, including to make information publicly available for reference. An SR is approved by the Technical Committee which produced it.
- **ETSI Group Specification (GS)** – Provides technical requirements or explanatory material or both. Produced and approved within our Industry Specification Groups (ISGs).

http://www.etsi.org/standards/different-types-of-etsi-standards

EN 300 421 V1.1.2 (1997-08)

European Standard (Telecommunications series)

**Digital Video Broadcasting (DVB);
Framing structure, channel coding and modulation
for 11/12 GHz satellite services**

European Broadcasting Union EBU UER Union Européenne de Radio-Télévision

DVB Digital Video Broadcasting

ETSI

European Telecommunications Standards Institute

Historic evolution of DVB satellite standards

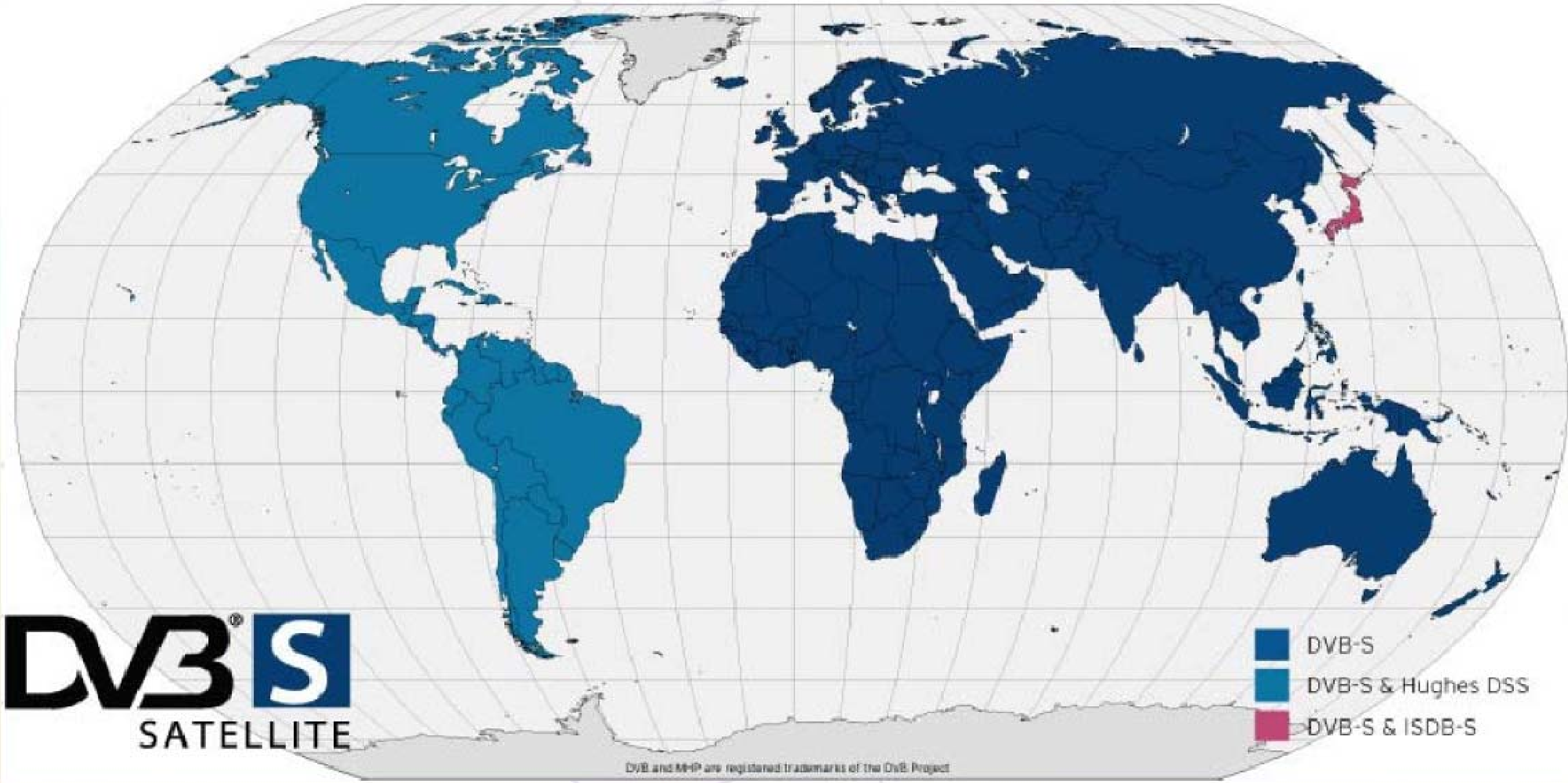
SATELLITE

EN 301 322
DVB-S + 8PSK & 16QAM
Contribution links (high capacity)

>2014: DVB-S2 Extensions

EN 300.421
QPSK
R-S + Convolutional
MPEG-2
SDTV DTH (Broadcasting)
Contribution links

EN 302 307
New input streams
New modulations
New channel coding (LDPC+BCH)
Three operation modes (CCM, VCM, ACM)
HDTV Broadcasting
Professional applications
IP-UNICAST services


DVB
S
SATELLITE
DVB-S
DVB-S & Hughes DSS
DVB-S & ISDB-S
DVB and MHP are registered trademarks of the DVB Project

An example: Broadcasting by different physical media

APPLICATION	CHANNEL CODING TECHNIQUE	MODULATION TECHNIQUE	OPTIMIZED FEATURE
Satellite- TV (DVB-S)	Strong	QPSK	C/N
Cable-TV (DVB-C)	Weak	M-QAM	Bandwidth used
Terrestrial-TV (DVB- T)	Intermediate	COFDM	Multipath protection

Satellite Broadband Standards

	DVB-RCS	DOCSIS	IPOS
Original Outbound	DVB-S	DOCSIS 1.1	DVB-S
Current Outbound	DVB-S2	DOCSIS 2.0	DVB-S2
Inbound	MF-TDMA	TDMA	MF-TDMA
Status of standard	Robust / deployed	Used by Viasat in Surfbeam (Tooway)	Used by Hughes
Higher OSI layer support	In development (DVB-RCS2)	Yes	Yes
Higher level support (i.e. management functions)	In development (DVB-RCS2)	Significant	Reasonable amount
Bandwidth efficiency	70 – 85%	Not Known	90% claimed
Observations	Perceived high cost	High volume orders	HNS claim low cost / high performance
Manufacturers	Many US and European	VIASAT using Broadcom Chips	HNS

Table 11 - Comparison of 3 key satellite broadband standards

http://stakeholders.ofcom.org.uk/binaries/research/technology-research/2011/Understanding_Satellite.pdf

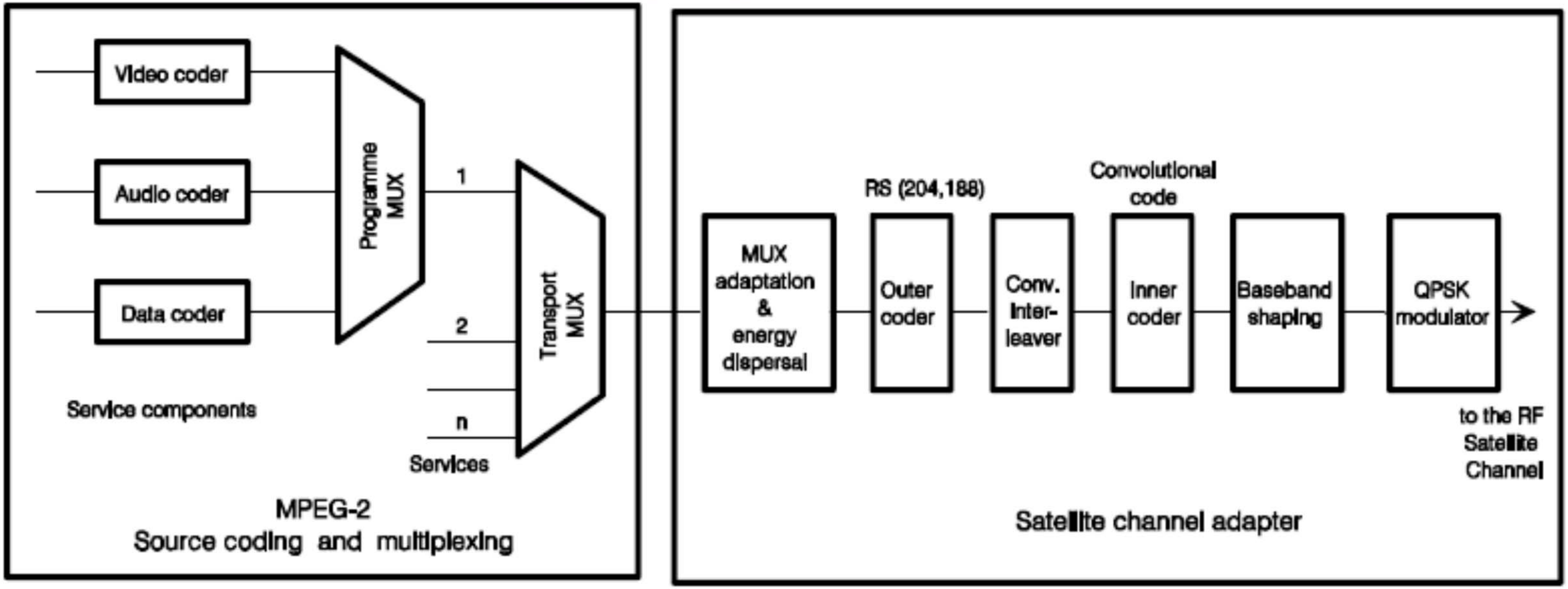
Understanding Satellite Broadband Quality of Experience – Final Report

Produced for: Ofcom

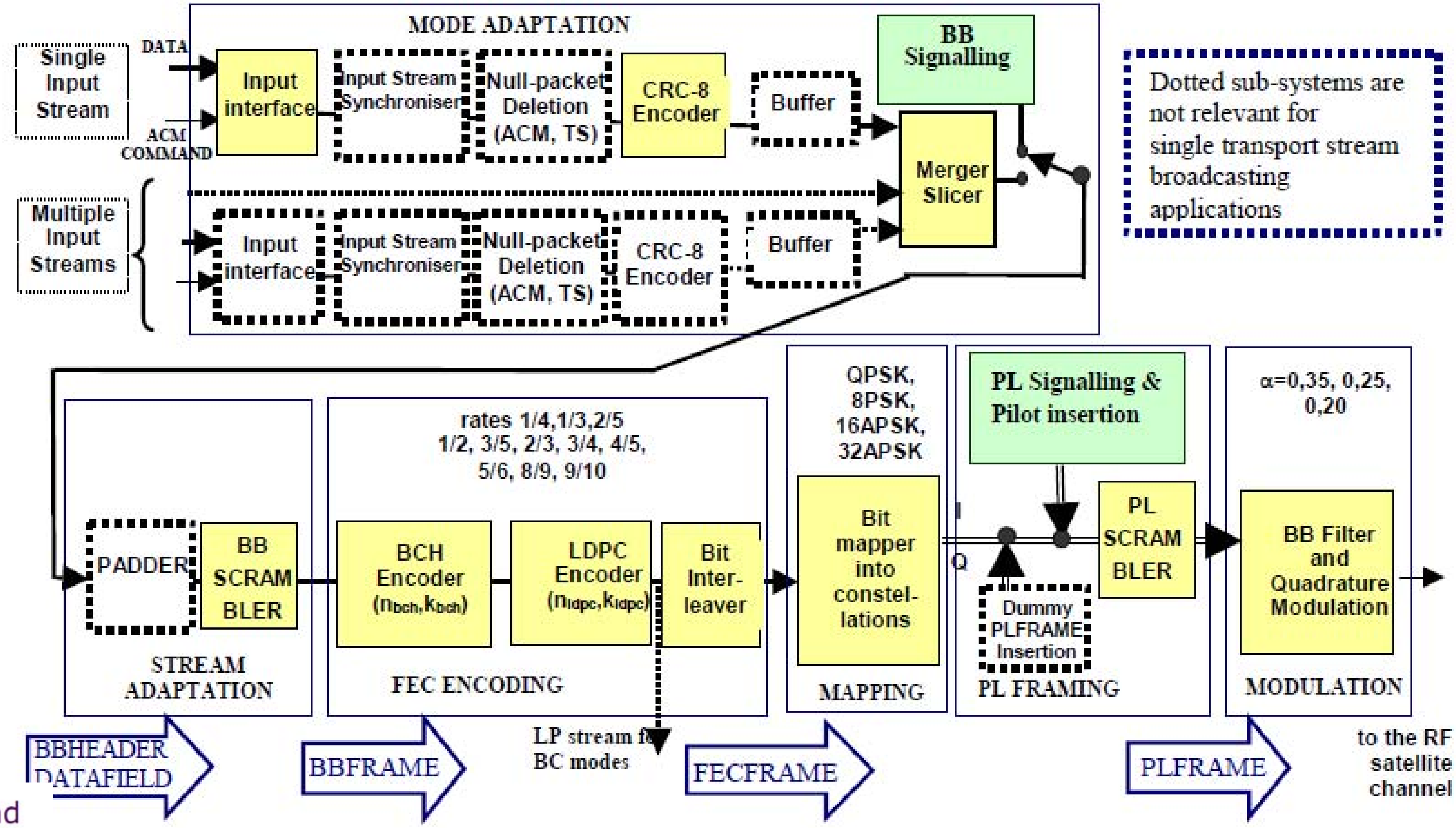
Against Order: 41000 18636

Report No: 72/11/R/193/R
July 2011 - Issue 1

DVB-S


Video coder
Audio coder
Data coder
Programme MUX
1
2
n
Transport MUX
Service components
Services
MPEG-2
Source coding and multiplexing
MUX adaptation & energy dispersal
RS (204,188)
Outer coder
Conv. Inter-leaver
Convolutional code
Inner coder
Baseband shaping
QPSK modulator
to the RF Satellite Channel
Satellite channel adapter

DVB-S2



Understanding Satellite Broadband Quality of Experience – Final Report

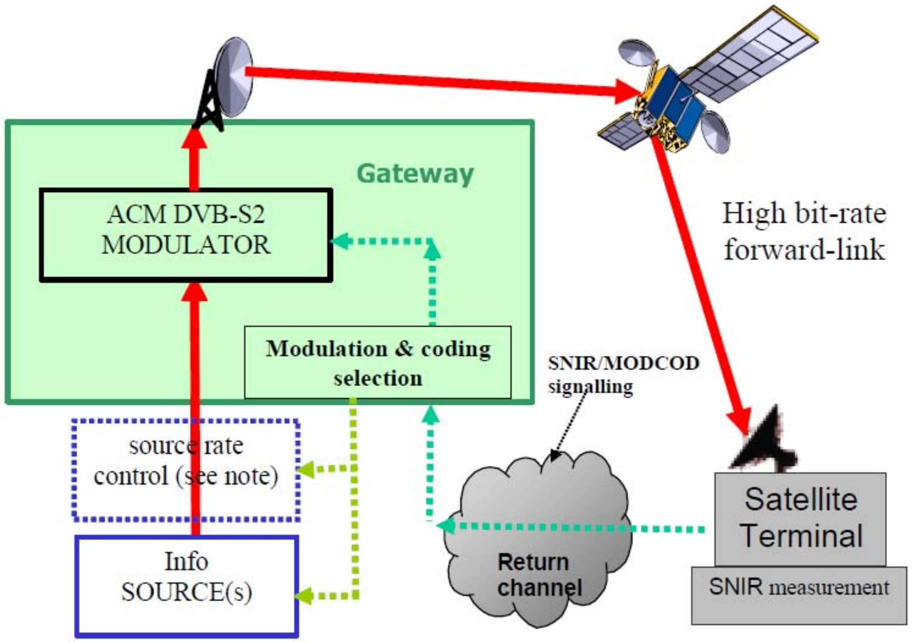
Produced for: Ofcom

Against Order: 41000 18636

Report No: 72/11/R/193/R
July 2011 - Issue 1

Figure 66 - Functional block diagram of the DVB-S2 system

DVB-S2X versus DVB-S



https://www.dvb.org/standards

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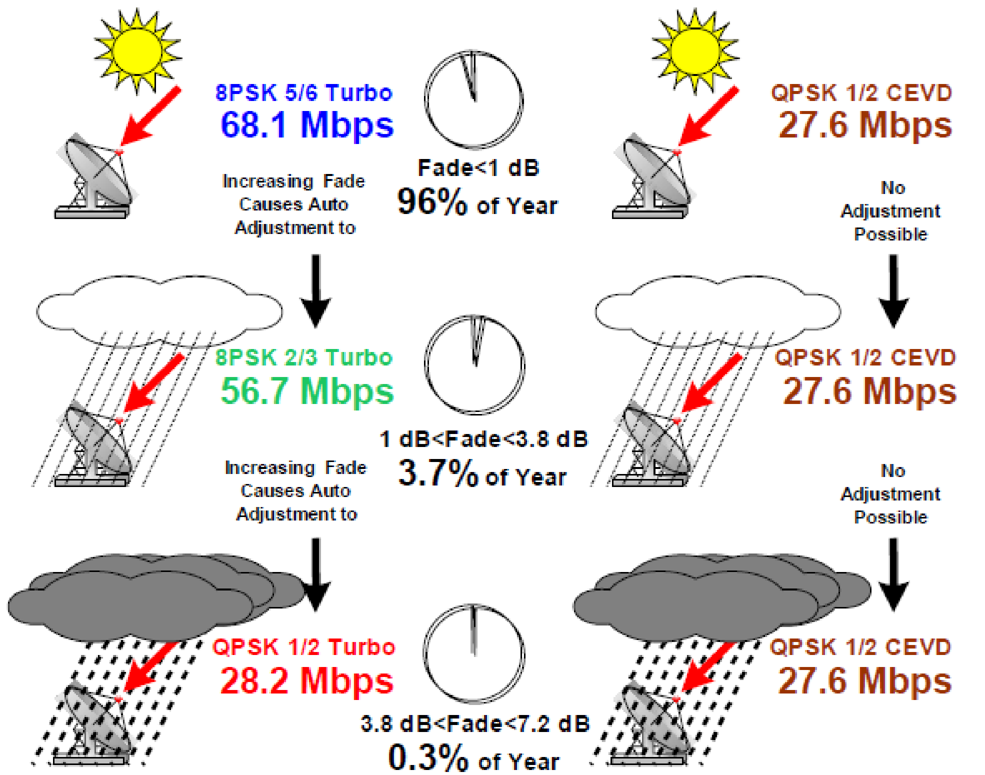
- There are **four modulation modes** available, with QPSK and 8PSK intended for broadcast applications in non-linear satellite transponders driven close to saturation. 16APSK and 32APSK, requiring a higher level of C/N, are mainly targeted at professional applications such as news gathering and interactive services.
- DVB-S2 uses a very powerful **Forward Error Correction** scheme (FEC), a key factor in allowing the achievement of excellent performance in the presence of high levels of noise and interference. The FEC system is based on concatenation of BCH (Bose-Chaudhuri-Hcquengham) with LDPC (Low Density Parity Check) inner coding.
- **Adaptive Coding and Modulation** (ACM) allows the transmission parameters to be changed on a frame by frame basis depending on the particular conditions of the delivery path for each individual user. It is mainly targeted to unicasting interactive services and to point-to-point professional applications.
- DVB-S2 offers **optional backwards compatible** modes that use hierarchical modulation to allow legacy DVB-S receivers to continue to operate, whilst providing additional capacity and services to newer receivers.

Tooway™
DOCSIS® standard

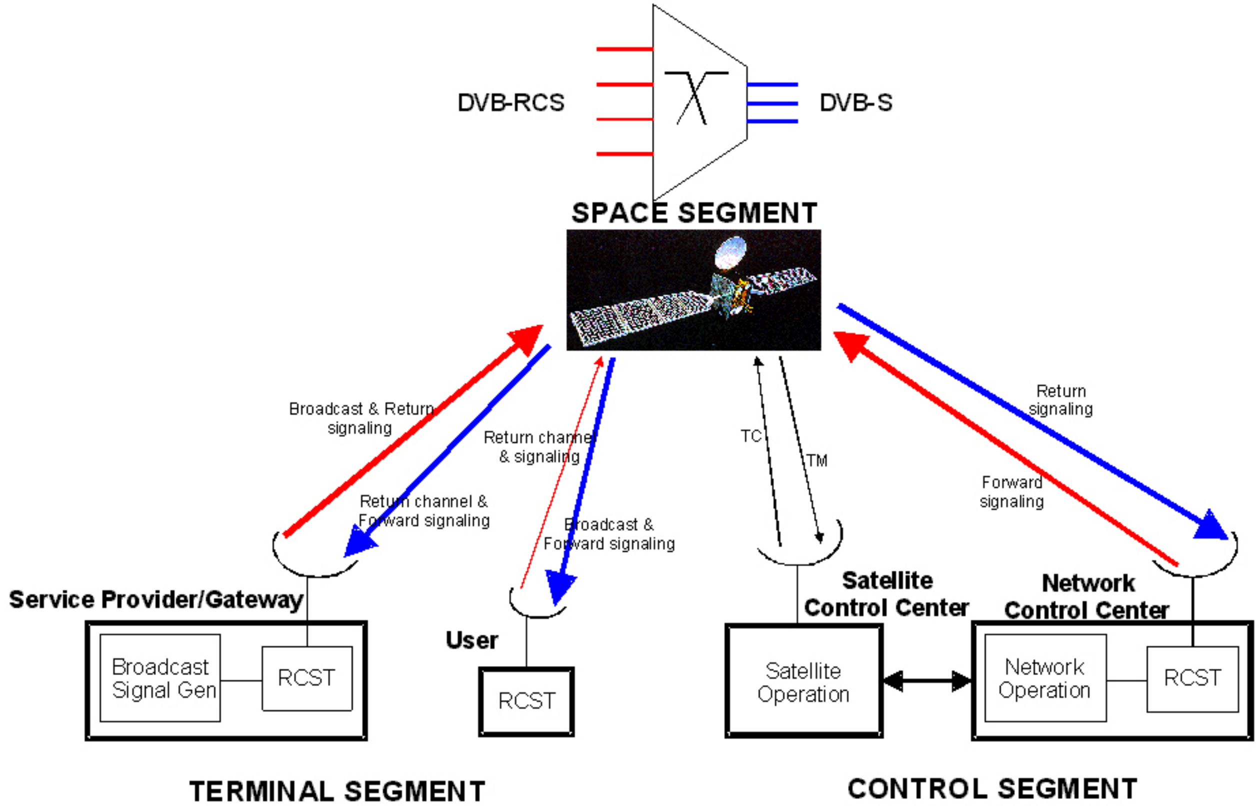
A **RETURN LINK** is required !

SurfBeam Multi-Rate PHY	**DVB - S** (Static PHY)



SurfBeam Throughput: **67.56 Mbps** Averaged over Year	DVB-S Throughput: **27.6 Mbps** Averaged over Year

DVB-RCS /RCS2



The DVB-RCS specifications were developed in response to requests from several satellite and network operators who wanted to embark on large-scale deployment of such systems and who considered it essential to have an open standard in order to mitigate the risks associated with being tied to a single vendor. The standards were developed using state-of-the art techniques, allowing an optimized trade-off between performance and cost. As consensus-based standards, these DVB specifications also have a controlled evolutionary future, secured by global contributions to the system under an agreed and open framework.

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In its basic form, DVB-RCS/RCS2 provides "hub-spoke" connectivity; i.e., all user terminals are connected to a central hub that controls the system and acts as a traffic gateway between users and the wider Internet. User terminals consist of a small indoor unit, and an outdoor unit with an antenna size not much bigger than a conventional direct-to-home TV receiver. Since the satellite terminal also transmits data, the outdoor unit includes an RF power amplifier.

User terminals offer an IP-over-Ethernet connection for wired (or wireless) interactive Internet connectivity for a local home or office network ranging from one to several users. In addition to providing interactive DVB services and IPTV, DVB-RCS/RCS2 systems can thus provide full IP connectivity anywhere there is suitable satellite coverage.

The core of DVB-RCS/RCS2 is a multi-frequency Time Division Multiple Access (MF-TDMA) transmission scheme for the return link, which provides high bandwidth efficiency for multiple users. The demand-assignment scheme uses several capacity mechanisms that allow optimization for different classes of applications, so that voice, video streaming, file transfers and web browsing can all be handled efficiently. DVB-RCS supports several access schemes making the system much more responsive, and thus more efficient than traditional demand-assigned satellite systems. These access schemes are combined with a flexible transmission scheme that includes state-of-the-art turbo coding, several burst size options and efficient IP encapsulation options. These tools allow systems to be fine-tuned for the best use of the power and bandwidth satellite resources. In addition, DVB-RCS2 also includes CPM for use with amplifiers in saturated mode.

The forward link is shared among a population of terminals using the highly efficient DVB-S2 standard (EN 302 307). Adaptive transmission to overcome variations in channel characteristics (e.g., rain fade) can be activated in both the forward and return links.

Beyond the basic hub-and-spoke architecture, the DVB-RCS air interface has also been deployed in systems that provide direct terminal-to-terminal "mesh" connectivity, either through satellite on-board processors that mirror the functions of a ground-based hub, or through transparent satellites, using terminals equipped with an additional demodulator.

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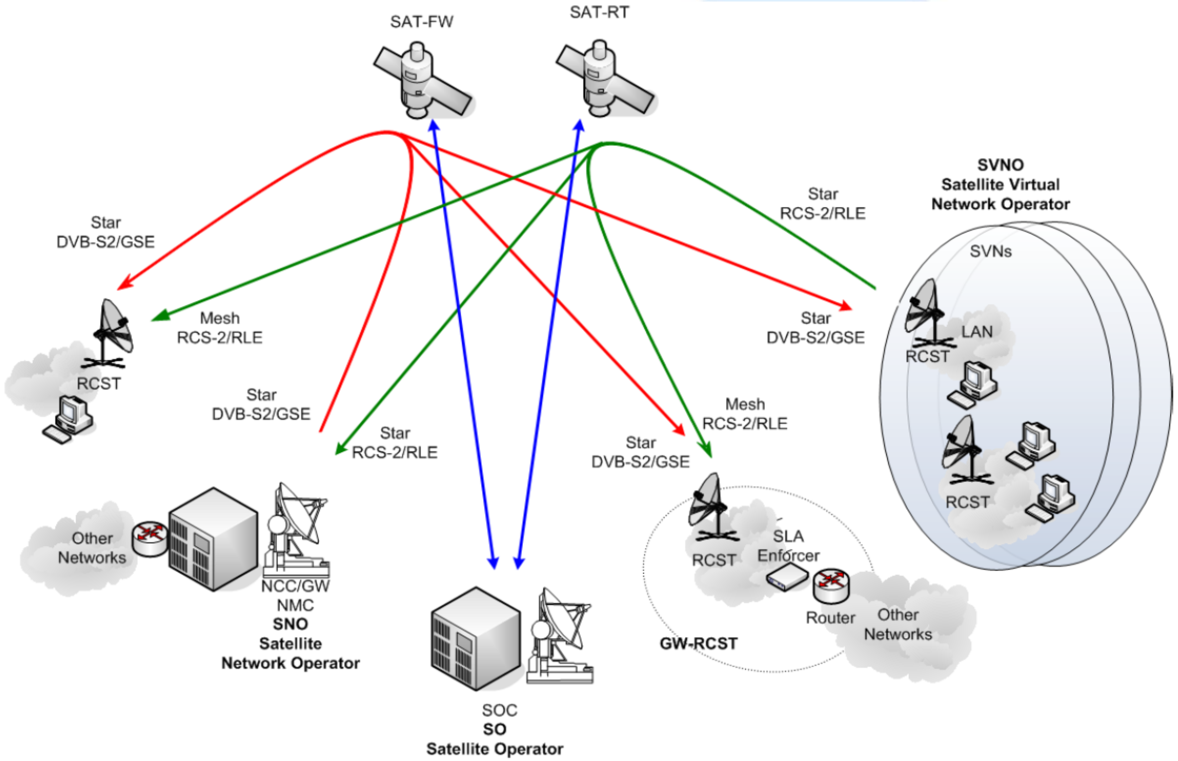

Figure 1: Main roles in a DVB-RCS2 transparent satellite interactive network

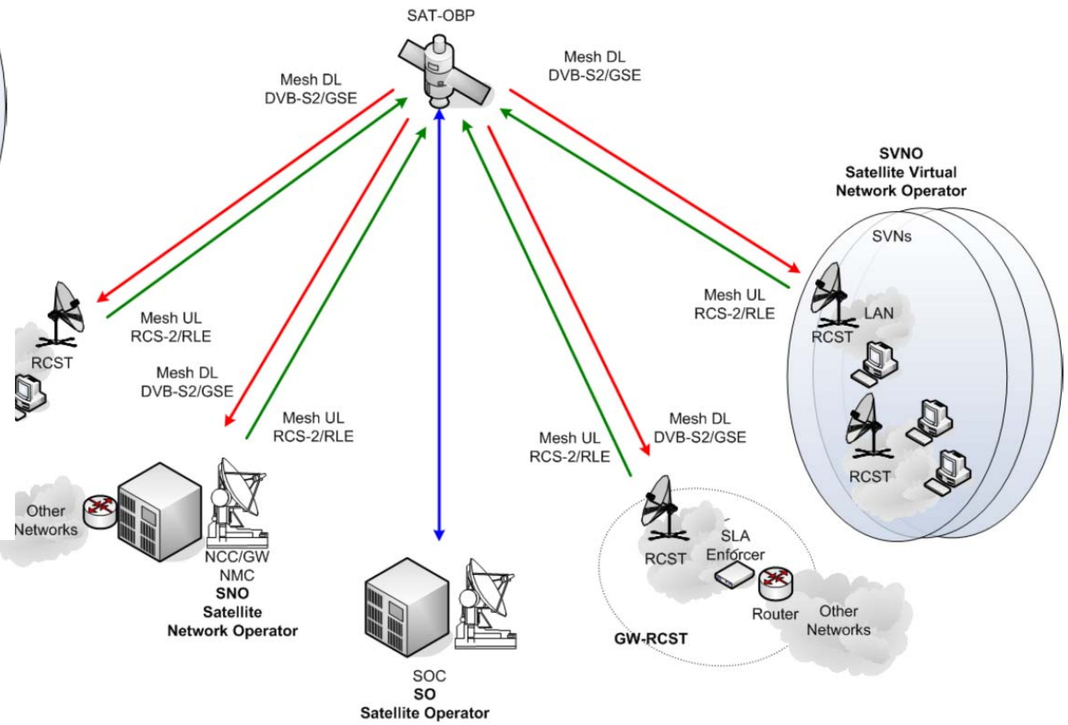

Figure 2: Main roles in a DVB-RCS2 regenerative satellite network implementing mesh topology

DVB Fact Sheet - August 2012. **Return Channel Satellite**

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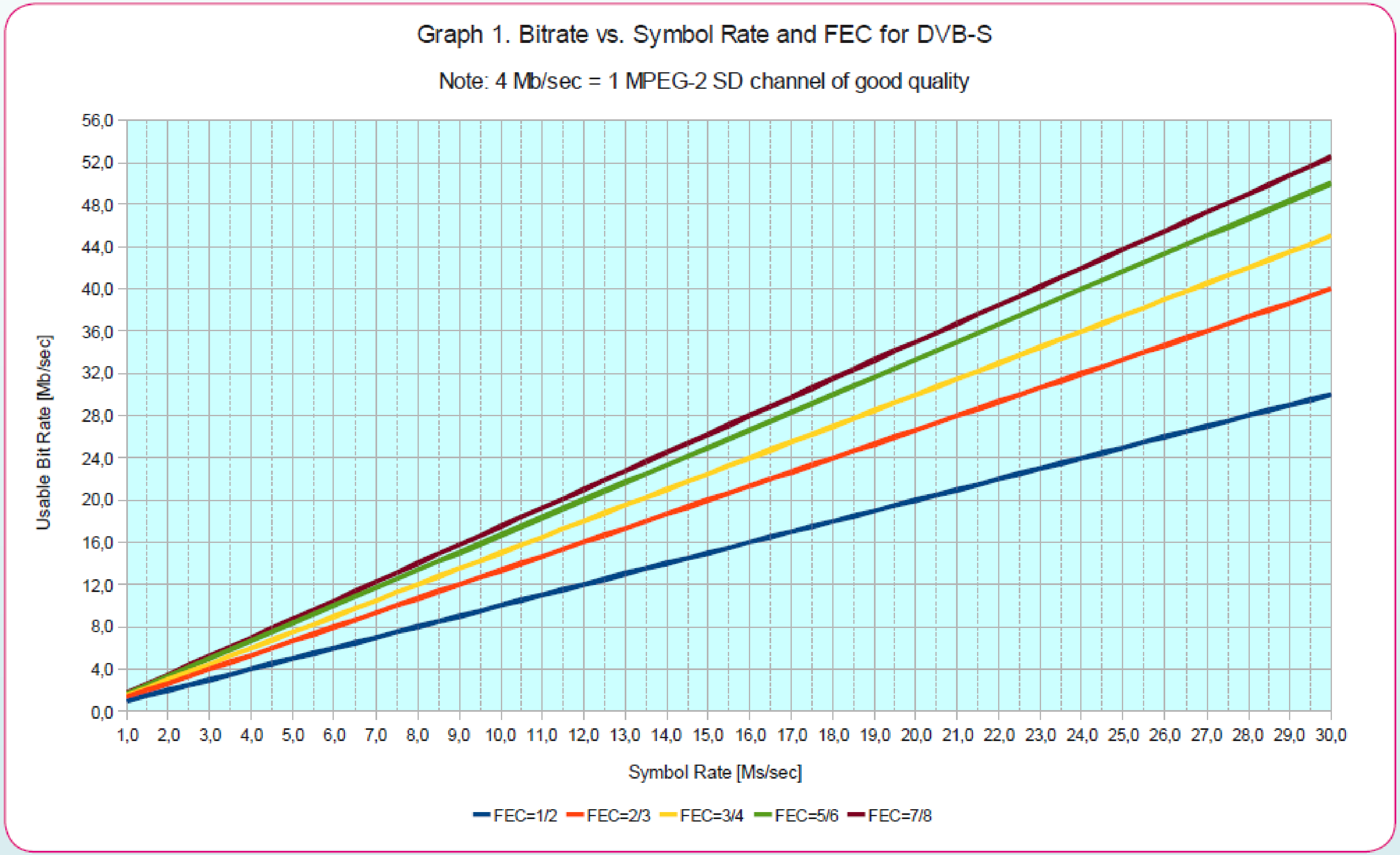
DVB-RCS versus DVB-RCS2

Features:	DVB-RCS	DVB-RCS2
Harmonised management & control	None	Yes (optional)
Harmonised IP-level QoS	None	Yes
Multiple virtual network support	None	Yes
Security	Single solution	Support for multiple security systems, for applications with widely different requirements
Return link access scheme for traffic	TDMA, continuous carrier	TDMA, continuous carrier, random-access
Modulation schemes	QPSK	Linear: BPSK, QPSK, 8PSK, 16QAM, Constant-envelope: CPM
Channel coding	RS/convolutional, 8-state PCCC turbo code	16-state PCCC turbo code (linear modulation), SCCC (CPM)
Burst spread-spectrum	Burst repetition	Direct-sequence
Return link adaptivity	Limited support	Inherent in air interface (TDMA and continuous carrier)
Bandwidth efficiency	N/A	30% improvement over DVB-RCS

How many TV channels per transponder?



Fuente: J. Pablowski, Tele-Satellite, 2011.

Satellite Transmission Standards

Satellite is one of the few communications industries where open standards are the exception to the rule, and proprietary technology dominates the market. For classical VSAT systems, some industry standards have emerged, while **the satellite broadband sector is still dominated by proprietary technologies**, despite the emergence of several open standards in recent years.

On the other hand, until now, most satellite broadband providers have been using proprietary technology. Complicating the situation is the emergence of three competing broadband standards: **DVB-RCS (Digital Video Broadcasting-Return Channel via Satellite)**, the satellite version of **DOCSIS (Data Over Cable System Interface Standard)** and **IPoS (IP over Satellite**). They are evolving absent any concerted talk of the benefits or advantages of interoperability. Result: Systems that cannot talk to each other. Moreover, the lack of interoperability of hubs and broadband IDUs of the same standard effectively locks customers into single-vendor solutions.

There is necessity of standards to achieve the low-cost, high-performance solutions that are expected to drive demand and growth of two-way broadband satellite. VSAT vendors argue that their customers are more worried about application performance, notably for applications like VoIP and VPN, than about standards. However, Governments are more interested in seeing standard systems deployed. Tenders specify that technologies submitted must be standard-based.

http://dvb-rcs-mcpc-scpc.atrexx.com/

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- BSM
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BSM

DVB-S

Galileo

Satellite UMTS/IMT-2000

Satellite for Transport

The world's population relies increasingly on satellite services for many different purposes, including voice and data communication, radio and television broadcast, distribution and contribution links, location services, maritime and aeronautical communications.

ETSI's activities concerning satellite communications include satellite communication services and applications (including mobile and broadcasting), earth stations and earth station equipment, especially the radio frequency interfaces and network and/or user interfaces and protocols implemented in earth stations and satellite systems.

Download the satellite technology leaflet

Technology Leaflets

http://www.etsi.org/technologies-clusters/technologies/satellite

Question 2.3

What are the values of the table.....?

ANSWER 1:
X= 8 dB , Y= 20 dB

ANSWER 2:
X=28 dB , Y= 20 dB

ANSWER 3:
X=8 dB, Y= 10 dB

ANSWER 4:
X= 28 dB , Y= 10 dB

BOLETÍN OFICIAL DEL ESTADO

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PARÁMETRO		UNIDAD	BANDA DE FRECUENCIA	
			47 MHz - 862 MHz	950 MHz - 2.150 MHz
Relación Port./Ruido aleatorio				
C/N FM-Radio		dB	≥ 38	
C/N AM-TV*		dB	≥ 43	
C/N QPSK-TV	QPSK DVB-S	dB	> 11	
	QPSK DVB-S2		> 12	
C/N 8PSK DVB-S2		dB	> 14	
C/N 64QAM-TV		dB	X= ???	
C/N COFDM-DAB		dB	≥ 18	
C/N COFDM TV		dB	≥ 25	
Ganancia y fase diferenciales				
Ganancia		%	14	
Fase		°	12	
Relación portadora/interferencias a frecuencia única				
AM-TV*		dB	≥ 54	
64 QAM-TV		dB	≥ 35	
QPSK-TV		dB	≥ 18	
COFDM-TV		dB	Y= ???	

REFERENCES

- *John G. Proakis, Masoud Salehi, "COMMUNICATION SYSTEMS ENGINEERING", 2nd ed., Prentice Hall, 2002.*

- *Bernard Sklar, "DIGITAL COMMUNICATION", 2nd ed., Prentice Hall, 2001*

- *Bruce R. Elbert. "THE SATELLITE COMMUNICATION APPLICATIONS HANDBOOK"*. 2004. Artech House, Inc.

- *"HANDBOOK ON SATELLITE COMMUNICATIONS (HSC)". International Telecommunications Union . April 2002. Wiley.*

- *H. Tripp et al. "UNDERSTANDING SATELLITE BROADBAND QUALITY OF EXPERIENCE – FINAL REPORT". Ofcom. July 2011*

- *Apuntes de las asignaturas del Grado en Ingeniería de Tecnologías y Servicios de Telecomunicación: TEORÍA DE LA COMUNICACIÓN, SISTEMAS DE TRANSMISIÓN, TEORÍA DE LA INFORMACIÓN Y SISTEMAS DE TELECOMUNICACIÓN*